

An after-dinner speech to the Oxford and Cambridge Dining Club of Geneva
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“Radiation, Science and Society”

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Summary already released:

When 25,000 years ago, there was an environmental debate about the safety of fire, society agreed that hot meals and warmth at home were worth the real dangers of fire. But today, as shown at Fukushima, imagined dangers of radiation have spooked world opinion. Fear of nuclear radiation is not justified by science itself, rather it is a relic of the international politics of the Cold War era. The world economy will not support ten billion people unless science faces up to the educational challenge of restoring public trust in nuclear science and technology.

It will soon be Christmas. What gift should Science give to Society? Another Higgs? More stories of planets? Good coffee table stuff to inspire youth! Or something useful for the kitchen, as it were? I think that Science should be more proactive with its Christmas gifts and give the world what it really needs. It should stop playing a passive role. Society needs a source of carbon-free energy available at all times, but it is frightened by the clear answer, nuclear technology. Nuclear technology needs to be de-mystified and the threat posed by radiation needs to be carefully dispelled. Currently science fails to engage this educational challenge.

Life is a balance between risks and benefits. When a new technology comes along decisions have to be made by weighing the two, calmly considering all information. And so it was in 25,000 BC with fire, we may imagine. Fire was very dangerous, then as now. It can catch and generate a chemical chain reaction that kills many thousands every year. Animals run away from it but early man used his brain, suppressed his fear, studied it and domesticated it. The Anti Fire Protesters of 25,000 BC were right -- it is very dangerous and damaging to the environment. Nevertheless, it was fortunate for mankind that the environmental protesters lost the vote, before then retreating to a meal of uncooked food in their cold and damp accommodation. I suggest that few of us would be here this evening if they had prevailed. I also suggest that society today would find itself unable to make such a brave far-reaching decision as that made 25,000 years ago. Perhaps those who make the wrong decisions simply become uncompetitive and die out.

A similar challenge was posed by mechanised traffic when it first appeared on the roads. It was justifiably condemned by protesters as dangerous and liable to frighten the horses! In the UK it was reduced to a crawl by the infamous Red Flag Act of 1865. Fortunately, stimulated by the development of the internal combustion engine in Germany and France, the Act was repealed in 1896. With hindsight one cannot imagine the prosperity of the past 120 years without the technology of road traffic, dangerous though it still is. Just imagine what today's press might say “Scientific experts acknowledge that on a busy road with cars still permitted to carry young children and pregnant women, there are places, just a few metres away in the face of

oncoming traffic, where death is almost certain within a few seconds!” The answer should be, and was, education and training. Dangerous places? Don't go there!

But not all dangers are in the hands of men. On 11 March 2011 the NE coast of Japan suffered an exceptional earthquake that generated the greatest tsunami in 1000 years. When the earthquake struck, as a result of thorough training everybody in Japan knew what they should do and the devolved responsibility was very effective. In the region that was flooded there were 500,000 people at the time of the quake and all but 18,000 reached safety in the half hour before the tsunami reached the coast. This 96% survival rate was an extraordinary achievement by Japanese society.

The tsunami destroyed thousands of homes and businesses including 2 oil refineries, but all the nuclear power plants survived. However, because it destroyed the peripheral emergency cooling infrastructure for three of the reactors at Fukushima Daiichi, these subsequently suffered irreparable damage by over-heating, and there was a significant escape of radioactivity.

Although everyone knew about earthquakes and tsunamis and what to do, nobody knew about radiation, neither the general population nor the authorities. There was no plan at any level. Such a lack of education and leadership caused an implosion of confidence and public trust that has infected energy policies around the world. This has been exacerbated by the media, with their interest in a titillating story.

Yet there has been no death and no casualty from the radiation and there will none in the future. It is wrong to call it a radiation disaster or tragedy -- you cannot have Hamlet without a single casualty.

But there has been serious loss of life caused by the panic, the social stress and unnecessary evacuation, particularly among the elderly. Like the extra CO2 emissions and economic consequences of closing nuclear power plants, these were self inflicted, not caused by nuclear technology. The restrictions on contaminated food are such that one person would have to eat 5 tonnes of it in 3 months for the equivalent of a single CT scan – a simple calculation by putting in uncontroversial basic numbers.

But this is curious. It creates a demand for further supportive evidence and and for a basic explanation in radiation biology.

Radiation has been used in medicine for 100 years. No political secrets here, just the legacy of Marie Curie, familiar to most people. Moderate single doses, as given for a scan, and the high doses, given every day of a 4-6 week radiotherapy course, show that environmental safety restrictions could be relaxed perhaps by 1000 times without any risk.

At Goiania, Brazil, in 1987 a redundant hospital source of 20 million becquerels fell into the hands of scrap merchants, their families and children. They broke it open, painted themselves with the source that emitted a pretty blue light and invited their neighbours in to admire. In total 249 were contaminated, 4 died within weeks from Acute Radiation Syndrome (shut down of cell cycle and immune system), but after 25 years there has been no case of cancer with any possible connection to radiation -- zero. Two women, one with a very high internal dose, gave birth to healthy (but radioactive) children. The source was caesium-137, the very

same that has caused concern in Japan at levels many thousand times lower.

Why have we been so in awe of radiation?

Because during the Cold War we were told that we should be -- and popular culture absorbed and ran it like stories of cowboys and Indians. Also because, we worry that we cannot sense such radiation, even though it is cheap and easy to detect using smoke detector technology. Finally, because we have accepted the inept official international “safety” message. This was designed to appease fear by setting regulation safety levels as low as reasonably achievable (ALARA). These are supposed to dampen concerns, but they do not, and anyway are not related to risk.

Real safety is inbuilt to the design of Biology, the product of 1000 million years of evolution. In modern radiobiology it is understood how life is stabilised with active repair and protection mechanisms at the level of local cells, effective against all but the highest acute dose. Like the devolved personal reaction of the Japanese to a quake, these are fast and effective.

How should we view the safety of radiation? With respect and education, as we do of UV radiation in sunshine -- UV is another form of ionising radiation. We do not stop holidays in the sun but people are advised to be careful – in the US deaths from skin cancer are fewer than from road accidents but more than from fire.

So how much radiation is safe in the sense that no risk can be measured? about 1000 X current standards. That would be much less than a course of radiotherapy but roughly the same as having regular CT scans, up to ten a month. In fact it would reset safety levels to what they were in 1934. With such a change the cost of nuclear power might halve and public concern about waste should evaporate.

But how might we re-establish trust and confidence in science and society? Here we are in the company of the bankers! What do they do? They cover banknotes, the grubby pieces of paper that they want us to take seriously as valuable, with pictures of our own famous scientists as figures of trust! But real load-bearing trust only grows from education and personal study, not from a blind acceptance of authority or narrow expertise.

There are real dangers out there – population, economic and political stability, food and water as well as climate change. Radiation does not belong on this list, but nuclear technology is an essential part of the solution -- safer than fire, and bigger and more sustainable too. So the gift from science to society should be a proper education in the real safety of nuclear radiation.

Copies of the authors's book *Radiation and Reason* may be purchased from the website www.radiationandreason.com

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